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## REVIEWS

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*The Economic Resources of the Northern Black Hills.* By J. D. IRVING. With Contributions by S. F. EMMONS and T. A. JAGGAR, JR. (Professional Paper No. 26, U. S. Geological Survey, 1904.) Pp. 222. 20 plates, 16 figures.

THIS report treats of the general geology and the economic or mining geology of an area of about six hundred square miles on the northeast flank of the great central dome of the Black Hills.

The essential structural features are: (1) the great central dome, now very greatly reduced and dissected by erosion, of laccolithic granite; (2) a border of greatly metamorphosed Algonkian sediments, which have been compressed into isoclinal folds, and whose strike is, in this district, north-westerly; (3) a great series of Paleozoic, Mesozoic, and Cenozoic sediments which dip away to the northward from the central igneous core. The central granite mass gave off great intrusive tongues which cut the Algonkian schists in all directions. Numerous later intrusions of porphyry are found in nearly all the formations from Algonkian to Benton.

On pp. 20 and 21 is to be found an excellent feature of this paper, namely, a summary, in tabulated form, of the essential points of interest in connection with each formation. Besides giving the usual facts needed for correlation, there is an additional column which is devoted to the essential topographic characteristics of each formation. From an examination of this, one can readily grasp how important a means in correlation the topographical element may become.

The chief interest in this region lies, of course, in the mineral wealth, and it is this phase of the subject to which the major part of the report is devoted. The main productive mining district is included in an area of about one hundred square miles, extending from the town of Perry, on Elk Creek, northwestward to the town of Carbonate, on the east bank of Spearfish Canyon, with its widest and most productive portion between Terry Peak on the southwest, and Gorden on the northeast. In the neighborhood of Terry Peak there has been the greatest igneous activity and also the greatest ore deposition.

The ore deposits are classified as follows: (a) those in the Algonkian;

(b) those in the Cambrian; (c) those in the Carboniferous; (d) those in eruptive rocks; and (e) those in rocks of recent formation.

The ore deposits in the Algonkian rocks include gold ores, copper ores, and tin ores. Of these the gold ores are the most important. The gold ores are also the chief ores in the region as a whole. The celebrated Homestake mines are working these ores.

However frequent the eruptive dikes and sills in the various formations, it cannot be said that the origin of the ores is due directly to the presence of igneous rocks, though they may be the ultimate source of the mineralizing solutions which made the deposits.

The ores in the Algonkian rocks occupy fractures and crushed portions in the schists, and are generally found to be richest beneath the overlying impervious shales of the Cambrian system. There seem to have been two principal periods of mineralization, one previous to the rhyolitic intrusions, and the other later.

The copper ores occur in small patches in the schists, and, so far as known, associated with graphitic schists, the graphite being supposed to have reduced the copper from the copper solutions.

The tin, in the form of cassiterite, occurs in two forms: (1) in pegmatitic granite, and (2) in placers. These deposits were never very extensively worked, and have been almost entirely given up since the collapse of the tin enterprise in the southern part of the hills. The tin is too much scattered throughout the rocks ever to make it worth while to carry on extensive mining.

The ores in the Cambrian rocks are the ores of gold and silver in three forms, of which the second is the most important. These are: (1) gold-bearing conglomerates (fossil placers); (2) the refractory silicious ores; and (3) pyritous ores. Besides the gold and silver ores there are ores of tungsten, and lead and silver. The second group of gold and silver ores are called refractory because amalgamation has so far failed in their treatment, there being a great deal of secondary silica, pyrite, and fluorite in their constitution. They occur in channel-like bodies usually along the bedding planes of the dolomite, sometimes just beneath an impervious shale, and sometimes just below sills of igneous rock.

The ores in the Carboniferous limestone consist of two classes, neither of which is very important. They are likewise refractory, silicious ores of gold and silver, and ores of lead and silver. They were deposited, it is presumed, by ascending waters in fractures in the massive limestone, but without any particular concentration due to impervious beds, as in the earlier formations.

The ore deposits of later age are placer deposits along the numerous streams that head back in the central and older rocks of the region. Of all these the Deadwood placer is the richest.

The great number of admirable diagrams illustrating structure, and also the many excellent photomicrographs of the ores, are among the most valuable features of the report. The petrographic study of ore deposits is rightfully coming to command greater and greater attention from mining men as well as from scientists.

W. D. S.

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*Zinc and Lead Deposits of Northern Arkansas.* (Professional Paper No. 24, U. S. Geological Survey, 1904.) By GEORGE I. ADAMS, assisted by A. H. PURDUE and E. F. BURCHARD. With a section on "The Determination and Correlation of the Formations" by E. O. ULRICH. Pp. 113, and 27 plates and maps.

THIS paper is a preliminary report rather than a final treatise on the district with which it deals. It represents a further prosecution of the study of the whole Ozark region wherein the same general principles of ore deposition will, doubtless, be found to prevail. It is very timely, as the scientific exploitation of the area cannot be said to have more than begun. The prospect holes greatly outnumber the productive workings, and the mines that are in operation lead a rather spasmodic existence.

The report deals with an area, comprising Marion county, the northern part of Searcy, the eastern border of Boone, and the northeastern part of Newton county, coming within the Yellville quadrangle, which lies in the much dissected plateau portion of the Ozark region, and is underlain by comparatively undisturbed sedimentaries that dip slightly southward toward the Boston Mountains.

These sedimentaries comprise Ordovician, Silurian, Devonian, and Carboniferous strata which have been moderately folded, fractured, and brecciated.

Ore was reported as occurring in this district by Schoolcraft as early as 1818. There are two ore horizons, the Yellville dolomite, Ordovician, the oldest formation exposed in the area, and the Boone chert of the Mississippian series. The ores are chiefly zinc blende and galena, but there is also a minor quantity of oxidized ore mined from the upper workings, and some zinc silicate, calamine.

The general movement of underground water, which was the medium by which the ores were concentrated, was essentially the same as that